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Inland Waters and Lands
Western and Northern Region

Eaux intérieures et terres
Région de l'ouest et du nord

Canada

STRATEGY PAPER

IWD - NORTHWEST TERRITORIES
WATER QUALITY PROGRAM 1985 - 1990

NWT Programs
Inland Waters Directorate
Western & Northern Region
Environment Canada
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1. EXECUTIVE SUMMARY

The Inland Waters Directorate (IWD) has prepared a Strategy Paper to guide the design and implementation of a comprehensive water quality program in the Northwest Territories (NWT). The program will be administered from the IWD responsibility center in Yellowknife, NWT, and receive functional guidance and support from the IWD Water Quality Branch (WQB), Regina.

Currently, a small network of 22 stations designed in the 1960's provides limited water quality data for the one third of Canada in the NWT. The Strategy Paper proposes to significantly upgrade the existing program to produce water quality information capable of meeting increased demands from a wide range of users of this information.

The program will design, implement and operate a monitoring system of networks and surveys carefully targeted at real, current and near-future water quality issues on transboundary and interior watercourses of the NWT. Ambient water quality monitoring responsibilities are currently shared with Indian and Northern Affairs Canada. The Strategy Paper is intended to provide the boundaries within which a water quality monitoring agreement (as per Cabinet Decision 99-82 CD) can be negotiated between the two agencies. Advantages of an agreement include a more cost-efficient monitoring network and data base, increased sampling capability as required in certain situations, greater comparability of data, the elimination of redundant monitoring, as well as the possibility of an integrated data management system.

The water quality program provides for the promotion of water quality objectives on transboundary watercourses, on watercourses within the NWT and on those watercourses flowing into federal lands of significant interest such as for example, Nahanni National Park Reserve.

Through the NWT water quality program, IWD will be able to provide assistance to managing agencies when establishing water quality objectives. This may include procedural advice, technical data base analysis, the provision of scientific water quality guidelines, and the monitoring programs required to establish and evaluate water quality objectives.

There is an urgent need to develop the IWD NWT water quality program now. Development within the NWT, particularly in the gold mining and hydrocarbon sectors has expanded extensively across the NWT since the program was first established in the 1960's. Today, the present monitoring network is particularly deficient in monitoring levels and impacts of toxic metals, toxic organic compounds and hydrocarbons, and is now rapidly falling behind in these areas. Monitoring strategies must be established now to provide key baseline water quality information essential to the environmentally sound design of projects and associated infrastructure.

Users requiring more adequate water quality information include developers and their consultants, Indian and Northern Affairs Canada, NWT

Water Board, federal and provincial agencies responsible for transboundary management of water resources, Environmental Assessment and Review Process committees, Fisheries and Oceans, the Government of the Northwest Territories, Environmental Conservation Service (IWD and Parks Canada), the Environmental Protection Service, the NWT Land Use Planning team, and the public.

The potential for a significant increase in the level of development in the NWT, coupled with increasing local government and public concern for baseline monitoring and aquatic resources protection, presents an immediate challenge for defining and implementing an effective water quality program.

2. PURPOSE OF THE STRATEGY PAPER

IWD maintains a responsibility center in Yellowknife, NWT, that operates the day-to-day water quality program activities in the NWT. Currently, a small network of 22 stations designed in the 1960's provides some baseline water quality data for the one-third of Canada in the NWT. This network has been co-located with IWD hydrometric stations and is sampled by the Water Survey of Canada staff.

This existing water quality program has been subjected to a formal, strategical review wherein the ability to provide specific water quality information to current users is carefully evaluated. Three principal

factors account for the review of the NWT program at this time; specifically:

1. The range of development under consideration in the NWT is considerably more extensive now than was the case when the principal features of the water quality program were first established in the NWT in the 1960's. An examination of existing exploration for precious metals, base metals, uranium, hydrocarbon development, proposed hydroelectric development, and attendent transportation and utility networks, raises major concerns regarding the associated northern aquatic ecosystems.

   Current resource maps show an extensive pattern of precious metal exploration projects throughout the Central Arctic. Exploration for base metal mining is most intensive in the Mackenzie Mountains, particularly in the South Nahanni basin where ten sites are currently being explored in addition to the existing operating mine.

   Hydrocarbon exploration extends in an almost uninterrupted sweep from the High Arctic, down the Mackenzie Valley to the B.C. and Alberta borders. The southern half of the Mackenzie Valley oil pipeline is nearing completion while the northern half is currently in the engineering planning stages. In addition, a natural gas pipeline has been submitted to reviewing agencies that would extend from the Mackenzie Delta to Alberta. This corridor will soon be widened to include an upgraded highway from Fort Simpson to Wrigley.

   As development has expanded throughout the NWT, the deficiencies of the existing small water quality network have become increasingly apparent. The network is particularly deficient in monitoring levels and impacts of toxic metals, toxic organic compounds and hydrocarbons.

2. The range and number of users of water quality information in the NWT has broadened over the last few years. The Environmental Conservation Service (ECS) and IWD senior Management constitute major users of this water quality data. The data are used in national and regional assessments which characterize baseline conditions, trends, and provide an understanding of aquatic processes and system stability in the northern environment. Both the Long Range Transport of Air Pollutants Program (LRTAP) and the Toxic Chemicals Management Program (TCMP) will rely increasingly on baseline water quality data for the assessment of northern water quality conditions.

   Data monitored on NWT transboundary rivers are used by provincial and federal agencies responsible for transboundary management of water resources. Bilateral water resources negotiations as well as umbrella agreements administered by the Mackenzie River Basin Committee (MRBC) depend on adequate characterization of water quality

conditions at boundary crossings in order to establish mutually agreed upon water quality objectives.

The NWT Water Board is now planning a strategy for the development of water quality objectives on watercourses within the NWT. Both baseline ambient water quality monitoring as well as compliance monitoring will be required for this program. These water quality data needs may increase significantly for those watercourses affected by formal division of the NWT into two new Territories.

Development proponents and their consultants require baseline water quality information to incorporate appropriate abatement measures in the design of their projects. The demand for ambient baseline data by developers has increased significantly as the range of development in the NWT has become considerably more extensive than was the case when the principal features of the monitoring network were first established in the 1960's.

Baseline water quality information is also required by agencies such as the Environmental Assessment Review Process committees, Fisheries and Oceans (DFO), the Environmental Protection Service (EPS), the NWT Land Use Planning team (LUP), Parks Canada, INAC and GNWT when reviewing and establishing guidelines for development proposals. The information is essential for IWD when providing input into several NWT environmental assessment committees on which it participates.

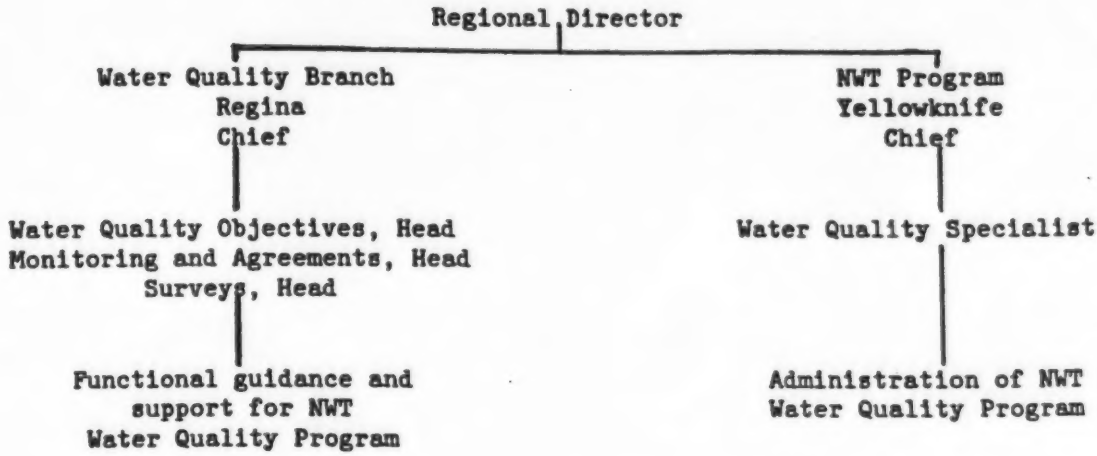
3. Both the pollutant types and the analytical methodologies have changed since the original program was first established. Heavy metal toxicants, for example, are now being effectively traced by southern WQB programs, not only in the water column, but also in sediments and in the biomass of a variety of biota. Similar monitoring strategies may be appropriately applied to emerging northern water quality concerns.

The potential for a significant increase in the level of development in the NWT, coupled with the local publics' increasing degree of concern for aquatic resources protection presents a very real challenge for defining an effective water quality program. To accomplish this IWD must carefully evaluate its operations within both present and future contexts. It must determine how effective it is now, as well as what is required in the future to provide information and advice on the quality of NWT inland waters to managers, developers, and the public to facilitate the wise management of the resource.

The Strategy Paper identifies the priority issues to be addressed in the water quality program and recommends a long-term direction for the development of water quality monitoring activities, including networks, surveys and studies, in the NWT. The procedures for promoting and assisting in the development of water quality objectives are defined. A comprehensive water quality strategy is then established which will allow for a subsequent detailed plan of action and future directions to be defined. This work is also intended to provide a framework for negotiating a water quality monitoring agreement with Indian and Northern Affairs Canada (INAC) in the short term, and possibly with the Government of the Northwest Territories (GNWT) in the longer term.

Table 2 provides an estimate of the resources required to implement the NWT water quality program over a five-year period. Apart from laboratory personnel, these resources will be located and administered by IWD from the Yellowknife office. The WQB - Regina will continue to provide expertise and functional guidance as required. A federal-territorial water quality monitoring agreement, pursuant to Cabinet Decision 99-82CD, is currently being discussed with INAC, and may determine the extent to which INAC will jointly manage and cost-share these monitoring activities. Details of the administrative elements of the NWT water quality program are provided in Figure 1.

Figure 1. Administrative Elements of the NWT Water Quality Program



Key IWD Agencies

Water Quality Branch - Ottawa
Monitoring and Surveys Division
NAQUADAT
Water Quality Objectives Division
Laboratory Services - Saskatoon
- Burlington
National Water Research Institute
- Burlington
- Winnipeg

Key NWT Agencies

INAC
NWT Water Board
EPS, AES, CWS
Parks Canada
GNWT
Publics

3. INLAND WATERS DIRECTORATE - MANDATE AND ACTIVITIES

3.1 Acts and Policy Statements

The mandate of the Water Quality Branch is discussed in detail in The Business of the Water Quality Branch (DOE.1984). The document outlines the basis of authority for the WQB's mandate by referencing to the Constitution Acts 1867-1981, the Government Organization Act, the Canada Water Act, the Federal Policy Statement on Inland Waters, and most recently, the 1982 Cabinet Policy directive providing for the cost-sharing of formal federal-provincial water quality monitoring agreements.

Together these Acts and policy statements delegate responsibility to IWD to carry out the following water quality monitoring activities:

1. carry out ambient water quality monitoring at boundary crossings and throughout federal lands;
2. contribute to national water quality assessment programs such as TCMP and LRTAP;
3. participate in interjurisdictional water quality agreements as required;
4. promote the establishment of water quality objectives as required;
5. contribute to the development of ambient water quality guidelines to assist responsible development; and
6. to inform the Canadian public on the state of Canadian water quality.

Particular policy direction for carrying out Departmental responsibilities relating to the NWT aquatic ecosystems is provided in the discussion paper Environment Canada in the North (DOE. 1983). The paper states that the DOE northern policy goal is:

> ". . . to ensure that the department's programs and activities contribute efficiently and effectively to the protection and enhancement of environmental quality in Canada's North, and to the achievement of environmentally sound, safe and sustainable northern development."

DOE emphasizes that its programs must follow a long-term, preventative approach which will clearly support environmental, conservationist policies. These policies are based upon environmental management principles which include:

1. the maintenance of essential ecological processes;
2. the preservation of unique northern ecosystems for posterity;
3. the elimination and/or mitigation of pollution discharges;
4. the consideration of synergistic effects of pollution in northern planning;
5. the undertaking of research and monitoring of northern environmental systems, and the utilization of results in northern environmental management;
6. the undertaking of intergovernmental cooperation on transboundary environmental issues; and
7. the education of the public on northern environmental issues.

The DOE Goal and attendent principles translate into four policy statements to guide DOE programs in the North.

1. Environment Canada will promote the establishment of a comprehensive network of protected areas in the North to provide adequate protection and management for areas and sites of significance in the preservation of Canada's natural or cultural heritage, or in the provision of opportunities for public appreciation and enjoyment of the North's natural and cultural features.

   . ambient water quality monitoring will be required to ensure the protection of aquatic systems associated with protected areas.

2. Environment Canada will promote environmentally sound technology and safe operations in northern resource exploration and development activities, in transportation and other infrastructure systems, and in community development programs.

   . aquatic systems research and ambient water quality monitoring of chemical, physical and biological characteristics and processes of northern aquatic systems will be required.

3. Environment Canada will encourage sustainable utilization of the North's renewable resources, sensible use of its non-renewable resources, and the resolution of transboundary environmental issues of concern in the North.

   . collection and dissemination of information on northern resource use patterns will be required.

   . coordinated water management plans which specify area-specific environmental guidelines will be required for resource management criteria.

4. Environment Canada will increase the information available to Canadians on the state of environmental quality and resource use in the North, and facilitate public consultations on northern environmental management policies and programs.

   . improved dissemination of information on the state and trends of northern environmental quality will be required.

Together these acts and policy statements commit IWD to developing a comprehensive water quality program in the NWT that will promote the preservation of the Northern aquatic environment and facilitate environmentally responsible development.

3.2 Goal

The overall goal of the IWD water quality program in the NWT has been defined by the authors of the Strategy Paper and derived from the Acts and policy statements listed above. The goal for the water quality program is:

> To promote the conservation and preservation of freshwater resources and to facilitate environmentally responsible development within the NWT, and at all boundary crossings, by providing relevant and timely information and advice to managers, developers and the public on the quality of inland waters.

3.3 Clients and Information Requirements

IWD will adapt its water quality program in order to respond to current client requirements for water quality information. This water quality information will often require data on sediment, biological communities, and physical and chemical descriptions of the water column. IWD clients and their NWT water quality information requirements are summarized in Table 1.

3.4 Present Activities

IWD currently operates 17 stations for the purposes of federal network monitoring. All stations have been co-located at hydrometric stations to enable samples to be taken by WSC staff. Sampling is limited to grab samples of the water column which are subsequently forwarded to the

Table 1. Clients and Their Information Requirements for Ambient Water Quality Characterization of Transboundary and Inland Watercourses of the NWT.

CLIENT	PURPOSE FOR WHICH INFORMATION IS REQUIRED
ECS	- national, regional water quality assessments
IWD-SM	- operation of national programs - i.e. LRTAP, TCMP
	- participation in comprehensive interjurisdictional water quality agreements (Mackenzie River Basin Committee)
Transboundary water resource managers	- characterization of water quality for negotiating bilateral agreements and establishment of water quality objectives.
Land use planning authorities, NWT Water Board	- designation of priority uses in NWT watercourses and establishment of water quality objectives.
INAC, EPS, environmental review committee, consultants, developers, GNWT	- reviewing development proposals and establishing guidelines for development affecting ambient water quality.
Public	- being informed on the state of the ambient water quality of inland water courses in the NWT.

Saskatoon and Burlington laboratories for physical and chemical analysis. The schedule approximates monthly sampling, the most remote sites being sampled only four times per year. The data are routinely published in Detailed Surface Water Quality Data reports and enable the production of periodic specifically interpreted water quality reports (e.g. Volume 9, Mackenzie River Basin Study).

Interjurisdictional monitoring is carried out at four stations on the Slave, Hay and Liard rivers. IWD has a cost-sharing Agreement with Parks Canada to carry out hydrometric work in Nahanni National Park Reserve. The agreement includes water quality monitoring of the Flat River at one station. The NWT Program also conducts high flow hydrometric rating measurements during spring freshet. Intensive water quality monitoring of the freshet period was undertaken at two stations during FY '84-85.

IWD samples an additional 22 stations, four times per year, under an informal agreement with INAC. These samples are forwarded to INAC - Yellowknife for analysis by INAC.

3.5 Evaluation of the Present IWD-NWT Aquatic Quality Program

IWD is responsible for describing the state of the aquatic system relative to the information requirements as noted in Section 3.3. This includes evaluating the water for its suitability for uses associated with potable drinking water supplies, the fishery, recreation and preservation of the essential functions and stability of the aquatic ecosystem. Implicit within the Strategy Paper is the conclusion that the current program contains inadequacies, as do most monitoring activities.

An informal review of the existing water quality network recently carried out by IWD staff shows that most stations are in locations that are relevant and adequate to meet many present and projected monitoring

responsibilities. The data base that has been established, principally over the last fifteen years, has provided a good first cut at defining background water chemistry characteristics for specific sites throughout the annual cycle. The best example of the use of this data base for this purpose is the summary water quality report prepared for the Mackenzie River Basin Study.

However, the summary report for the Mackenzie system demonstrated a number of limitations of the existing data base, most important of which are the lack of information on toxic organic compounds, inadequate chemical species determination, particularly for toxic metals, a complete absence of information on the biological structure and health of the aquatic systems, a general inability to define natural system variance (required to determine anthropogenically driven changes) and a general inability to identify emerging pollutant problems. In addition, the prospects of increased northern development and the attendant increase in both the number and quantity of pollutants discharged to the NWT waters places new demands on the monitoring program to produce increasingly more precise levels of information.

Currently, the program is operated as an "add on" responsibility for hydrometric technicians. The wide geographic area covered and the problems of remote access make this an efficient and realistic way in which to operate the program. However, the extent to which the program can be expanded following this arrangement is less than desireable. For

example, trained water quality technicians will be required to acquire more complex samples. This will require extensive retraining of current hydrometric technicians or pairing of hydrometric and water quality technicians.

Probably one of the most significant limitations of the NWT water quality program up until the past year has been that it was operated as an "add-on" responsibility to WQB district resource officers in the southern part of the Region. The limitations of this arrangement included a lack of direct association with other agencies (e.g. INAC, EPS, GNWT) operating within the NWT, a remoteness from the issues, arms length contact with the technicians and a general lack of time to review the program and the data. Fortunately, the foundations necessary to overcome this limitation were laid with the staffing of the IWD Water Quality Specialists' position for the NWT in Yellowknife in August, 1983.

It has been recognized for a number of years that periodic water quality monitoring is inadequate in itself for meeting the information needs noted above. Specialized surveys, recurrent studies, multi-media monitoring and interdisciplinary expertise are now necessary to fulfill these needs. This has generally not been part of the NWT water quality program due to the lack of resources to even effectively implement it within the southern part of the region.

Finally, the water quality data base available for the NWT is held by a

number of agencies. Integration of water quality activities among all agencies operating in the NWT is demanded by the remoteness and the limited resources available. To some extent this is achieved in the field activities but it is missing from the activities of data base management. Effort is essential to ensure a cooperative, inclusive data base for the NWT. As negotiations for an ambient water quality monitoring agreement proceed between INAC and IWD, responsibilities for data collection, management and interpretation must be clearly delineated.

4. OTHER WATER RESOURCES MANAGEMENT AGENCIES' MONITORING RESPONSIBILITIES

4.1 Indian and Northern Affairs Canada

4.1.1. Water Resources Division

All NWT waters are vested in the Crown and are administered by the Minister of INAC pursuant to the Northern Inland Waters Act. The Act provides INAC with administrative responsibility similar to southern provincial mandates for water resources management. Water withdrawals and effluent discharges to receiving waters in the NWT must be licenced (with the exception of domestic and emergency uses) under the Act. The Act establishes a strong regional authority (the NWT Water Board) to administer water licencing in the NWT. INAC holds the responsibility for enforcing the terms of a licence issued pursuant to the Act.

The licencee may be required by the licence to conduct various monitoring activities. Licence monitoring may take the form of monitoring the quantity of water withdrawal, monitoring the quality of discharged effluent and monitoring the quality of receiving waters closely associated with the effluent discharge. Monitoring may not be required at all, as is generally the case for community discharges. Industrial projects, such as mines, on the other hand, are typically required to monitor withdrawals, discharged effluents and often the associated receiving waters.

INAC also carries out pre-development ambient water quality monitoring of specific development projects. Proposed projects may be monitored once or twice per year, as INAC resources permit, through grab sample water quality monitoring. In certain situations, in depth surveys have also been undertaken. Sampling frequency in such cases is significantly increased and biological parameters are included in the pre-development monitoring.

INAC annually requests water quality grab samples to be collected by IWD under an informal agreement. Requested station locations coincide with existing IWD hydrometric stations and samples are forwarded by Water Survey of Canada staff to the INAC Yellowknife laboratory for analysis. This sampling allows extended coverage by INAC of pre-development project monitoring.

In addition to licencee spot-check monitoring and pre-development monitoring carried out by itself or by IWD, INAC also maintains a limited baseline network monitoring program. At present, the only District to operate the network is Fort Smith District, which maintains quarterly monitoring of baseline network stations. A few additional baseline network stations throughout the NWT are included in the requested IWD quarterly monitoring carried out on behalf of INAC.

There are aspects of the ambient water quality monitoring responsibilities held by INAC that have a direct bearing on the IWD NWT water quality program.

INAC monitoring at licenced projects such as communities or mines is classified as regulatory in nature, exclusively within the mandate of INAC, and does not arise in the present discussion.

The overall objectives of INAC and the IWD are, of course, very different in focus. INAC collects ambient water quality data to carry out its regulatory responsibilities, while IWD provides a general audit of ambient water quality on a broader scale. While the data generated by a monitoring program are used for different purposes, the data collected by one agency may actually serve the objectives of another. Examples of this exist where INAC and IWD sample at the same station, and where INAC has requested sampling at stations already sampled by IWD.

The two agencies should identify those aspects of their monitoring programs that will benefit from integrated planning and implementation. Benefits will include a more efficient monitoring network and information base, increased sampling frequency as required in certain situations, greater comparability of data from one station to another, the elimination of redundant monitoring, as well as the possibility of an integrated data management system.

A formal agreement, analogous to the existing NWT hydrometric agreement between IWD and INAC, will likely be required to pursue these undertakings.

4.1.2 The NWT Water Board

The NWT Water Board is charged with the administration of licencing pursuant to the Northern Inland Waters Act and derives its authority from the Act. The bulk of the licence drafting and required monitoring program design is carried out by the Board's Technical Advisory Committee, although the Board is not bound by even unanimous TAC recommendations. The Board, therefore, exercises significant influence over pollution control measures relating to the inland waters of the NWT. The Board consists of nine appointed citizens; three members nominated by each of INAC, DHW and DOE, three members appointed by the Minister of INAC, and three members nominated by the Executive Council of the NWT Legislative Assembly.

The Northern Inland Waters Act enables the Board to recommend priority use designations and associated ambient water quality objectives (referred to as water quality standards in the Act). The Board has not yet exercised these powers and neither has it, nor has INAC, yet engaged in any form of water resources planning analogous to the emerging NWT Land Use Planning process. It is possible that the latter process may stimulate or initiate water resources planning, the development of priority use designations and the establishment of water quality objectives for inland waters in the NWT.

IWD will develop a strategy for the cooperative planning and promotion of water quality objectives on appropriate watercourses in the NWT (see Section 5.2). The planning environment in which the NWT Water Board will undertake the establishment of water quality objectives, or standards, cannot be accurately described at present. Whichever scenario the Board develops, it seems likely that there will be a significant role for IWD to play in terms of promotion of water quality objectives, advice and assistance in the development of criteria upon which to base water quality objectives, and station location for baseline monitoring as well as monitoring for adherence to established water quality objectives.

4.2 Environment Canada

4.2.1 Environmental Protection Service

EPS holds regulatory powers with respect to the management of water

resources and is responsible for enforcing provisions of the Clean Air Act and the Environmental Contaminants Act within the NWT. EPS also administers Section 33 of the Fisheries Act (which prohibits the deposition of deleterious substances in waters frequented by fish) although these provisions are acted on only in lieu of regulatory action taken by INAC. Oil spill prevention training, a spill reporting service and environmental emergency contingency plans are maintained and/or developed by EPS.

EPS is increasingly developing a more pronounced advocacy role wherein increased planning and program coordination with other government departments allow it to provide advice on technical waste management, early environmental impact assessment and effective impact monitoring. Northern research directed at developing techniques for monitoring the impacts of development projects is encouraged and administered by EPS. Research and monitoring programs, such as the Norman Wells Research and Monitoring Group, are coordinated by EPS to assess the effectiveness of licence conditions. EPS carries out reviews and field assessments of freshwater impact assessment methodologies. A recent example is the EPS Northern Oil and Gas Activities Program proposal to carry out ambient water quality monitoring, effluent monitoring and associated sediment and aquatic biota monitoring at the Norman Wells project. In such situations where there may be a common interest, joint planning will be required to ensure that maximum use of IWD's and EPS' resources are applied to achieving compatible objectives associated with ambient monitoring. An

ongoing commitment to cooperative consultation in the formulation of work plans, programs and specific projects will be required by both agencies to ensure maximum cooperation and coordination.

4.2.2 Parks Canada

The National Parks Act, which applies for the most part both to existing Parks and Park Reserves (Nahanni National Park Reserve is an example of the latter), directs Parks Canada to maintain such natural areas and to leave them unimpaired for future generations. Regulations pursuant to the Act may be implemented to manage and protect the fishing, as well as to prevent and remedy any pollution of park waterways. Resource conservation objectives for Nahanni National Park for water are:

> "To preserve and protect the natural hydrological regime and water quality of Nahanni National Park waters by:
>
> a) establishing management strategies that ensure that no unnatural change in Park water quality occurs as a result of water flow into the Park; and
>
> b) establishing cooperative water management agreements with adjacent land management agencies to ensure the preservation of the South Nahanni and Flat Rivers as free-flowing wilderness rivers",

and for aquatic elements are:

> "To ensure the protection of aquatic ecosystems and maintenance of naturally-regulated fish populations in Nahanni National Park ...". DOE 1983a.

To this end, Parks Canada and IWD have entered into preliminary negotiations regarding joint management of a water quality monitoring program for Nahanni waters.

4.2.3 Canadian Wildlife Service

CWS is charged with administering the Migratory Birds Convention Act, Section 35 of which prohibits the discharge of wastes in waters frequented by migratory waterfowl. In practice, the focus of CWS activities in the NWT centers on a census of key waterfowl populations and a compilation of important waterfowl habitat sites in the NWT.

4.2.4 Atmospheric Environment Service

AES has provided weather information to support northern transportation and development operations in the NWT for approximately forty years. A network of meteorologic stations are operated throughout the NWT. As a member of the Western LRTAP Coordinating Committee, AES will play a key role in the development of the NWT LRTAP monitoring program.

4.3 Government of the Northwest Territories

The GNWT has no formal authority to undertake water resources management activities. This must be placed, however, in context of a gradual devolution of water resources management responsibilities from INAC to the GNWT. It is generally assumed by northern agencies that GNWT will ultimately take over responsibility for regulatory water resources management from INAC. Timing will reflect the increasing levels of Provincial responsibility accorded to the GNWT. Presently, the GNWT

holds formal negotiating status on interjurisdictional committees established by recommendations of the Mackenzie River Basin Committee.

The Executive Council of the GNWT Legislative Assembly has expressed an intention to increase the GNWT role in northern water resources management. The GNWT is currently undertaking long range strategic water resource planning. The planning has no operational component but provides interim direction until a mandate is provided allowing for operational responsibilities.

As the regional political representative of the people of the NWT, and as the probable future retainer of the principal water resources mandate in the NWT, the GNWT must be considered an equal partner in current water resource management activities.

Agreements between IWD and GNWT on specific issues where common concerns are identified, such as water quality resource mapping and overviews of interjurisdictional basins, have been undertaken to date in an effective, cooperative manner.

These types of working relationships will suffice until such time as the GNWT obtains a formal mandate for water resources management. At that time, the interrelationship should be re-evaluated for the possible development of a comprehensive formal water quality monitoring agreement which will jointly guide the two programs. Such an agreement may well

follow from any agreement previously negotiated between IWD and INAC over water quality monitoring of watercourses in the NWT.

5. ELEMENTS OF THE NWT WATER QUALITY PROGRAM

5.1 Issues

Resource Development

MINING constitutes the major development concern for water resources managers in the NWT. The construction, operation and abandonment stages are of particular concern, during which times tailings (including arsenic, cyanide, heavy metals) may be released to ambient receiving waters. Significant data gaps exist in regard to movement and dispersal of these contaminants in receiving waters and to their particular toxicological effects on northern aquatic biological populations. Concern for the aquatic environment exists not only for individual projects but also for the cumulative effects within a hydrologic system.

Gold and silver mining is currently focused primarily in the Central Arctic. Existing gold mines are expanding operations where possible and new gold mines continue to go into development. Base metal mining (e.g. lead, zinc, tungsten) takes place south of Great Slave Lake, but is most intensive in the Mackenzie Mountains, and particularly in the Nahanni watershed. Uranium exploration is most intensive in the Baker Lake region, but also extends throughout the Central Arctic.

HYDROCARBON exploration occurs in the High Arctic islands, but is most intensive throughout a large portion of the Mackenzie Valley. A crude oil pipeline from Norman Wells to Zama Lake, Alberta is currently under construction, while an additional line from Norman Wells to the Mackenzie Delta is under consideration by Esso Resources Ltd. Polar Gas Ltd. has recently proposed a natural gas pipeline to also extend from the Mackenzie Delta to Alberta.

Hydrocarbons may enter receiving waters in the NWT from line ruptures or leaks, as well as from processing sources from Alberta (via the Slave River) and from the Esso Resources Ltd. refinery at Norman Wells. Ambient monitoring techniques for hydrocarbons are at present poorly developed.

MAJOR HYDROELECTRIC AND DIVERSION projects have been considered by southern proponents that could significantly affect the environmental resources of the Slave and Liard rivers, and ultimately, the downstream Mackenzie system. The current economic situation relegates these projects to far future concerns.

Infrastructure Development

Resource development stimulates the expansion of existing communities and the development of new communities, with their need to dispose of municipal wastes. New winter and all-weather roads will continue to be

built, particularly in the Mackenzie Valley, but also in the Central Arctic.

Additional Toxic Substances

Additional industrial toxic substances are generally restricted to isolated locations such as DEW Line stations, making removal of these waste materials expensive.

Non-inventoried wastes at these sites may be toxic and potentially capable of impacting the environment. As well, herbicide/pesticide use which is very limited within the NWT, is a concern due to the potential of transport from adjacent jurisdictions via interjurisdictional waters

Interjurisdictional Aquatic Quality

A number of water systems of the NWT are, in fact, interjurisdictional. Most notable is the Mackenzie River system which includes the Slave, Hay, Liard and Peel Rivers. IWD has a responsibility to minimize or assist in the resolution of water use conflicts between jurisdictions, and to promote and assist in the establishment of water quality objectives.

Interprovincial and provincial-territorial water issues require extensive involvement including preplanning, development of water quality objectives, preparation of aquatic quality assessment reports and the

provision of technical advice to water managers. As development continues within the NWT and the northern part of the adjacent provinces and as the need to protect the surface aquatic resources is more forcefully pursued by resource managers and the public, the level of activity in resolving or preventing interjurisdictional conflict will increase.

Long Range Transport of Atmospheric Pollutants (LRTAP)

Environmental concerns in the NWT will not simply be limited to areas of local resource and infrastructure development. The acid rain phenomenon has clearly demonstrated the potential for serious environmental consequences of pollutant discharges to the atmosphere thousands of miles from the area impacted. Large portions of the NWT are likely susceptible to acid rain due to the lack of buffering capacity of the water soils and bedrock. The magnitude of the problem is unknown at this time, due to a lack of aquatic and terrestrial sensitivity information and the absence of information quantifying deposition from the atmosphere to the terrestrial and aquatic environments. Due to the semi-arid nature of much of the NWT, it is possible that loadings are low in comparison to other severely impacted regions of the country; however, the sensitivity of the water, soils, vegetation and other life remains unknown.

Recent studies have demonstrated that due to the atmospheric conditions characteristic of the north, the cold Arctic high pressure air mass tends

to accumulate high concentrations of potentially contaminated aerosols. This phenomenon, known as "arctic haze", has the potential to severely and ubiquitously impact remote and otherwise pristine environments. These aerosols are industrially, agriculturally and, to some extent, naturally derived. Analyses of these aerosols in the Arctic indicate a highly variable level of contamination of metals and other toxic substances.

Aquatic Quality on Federal Lands

Although the Territories are managed as Federal lands by INAC, this section refers specifically to the large tracts of lands which will be maintained as federal lands in the form of national parks and reserves. The management agency has the responsibility of measuring and assessing the aquatic quality of these lands in order to determine baseline conditions, to aid in the establishment of water quality objectives, and to provide advice and ongoing measurement and assessment activities. This may be done most efficiently by having one federal agency, IWD for example, be responsible for data collection. Large tracts of land have been identified or already set aside within the NWT for this purpose and thus this could constitute an important commitment on the part of IWD.

Conservation

The protection and conservation of renewable aquatic resources will

likely emerge high on any list of local priorities, especially insofar as a high proportion of NWT residents derive their sustenance and ability to participate in the cash economy from harvesting aquatic resources. In addition to local environmental concerns, there are approximately 100 areas of special environmental interest (including Territorial and National parks, International Biophysical Program (IBP) sites, sanctuaries, historical sites and potential heritage rivers) designated primarily by DOE. Together, these lands and surface waters cover approximately 20% of the NWT. Tourism will likely increase in the NWT, particularly as new transportation links are opened up. Tourism may be further stimulated by the conclusion of the Economic Development Agreement between Canada and the GNWT.

Other

There exists a number of other concerns in the NWT which may be relatively minor at present but may expand in the future. For example, there is only limited exploitation of the forest resources in the Liard, Hay and Slave River basins. However, the overall development of the NWT may promote exploitation of the forest resources, particularly as transportation systems expand and improve.

5.2 Water Quality Objectives

A water quality objective is a numerical concentration limit or narrative

statement based on water quality quidelines and relevant socio-economic factors, which has been negotiated to support and protect the designated uses of water at a specified site.

Water quality objectives have a direct bearing on the goal of the NWT water quality program. They may be used to:

a) assist in water quality management of upstream and downstream uses at NWT-provincial/territorial boundaries by designating the conditions required to protect water uses;

b) guide regulating agencies when establishing pollution control requirements;

c) provide a means of assessing the general health of a watercourse (i.e. environmental management targets); and

d) assess water quality data gaps and define related research requirements on specific watercourses.

When the NWT water quality monitoring strategy advances to detailed operational design, those watercourses will be identified that will be best suited to the establishment of water quality objectives. It will become the role of IWD to promote the establishment of water quality objectives on these watercourses and to lend assistance as required from IWD's area of expertise.

IWD can provide procedural advice, data analysis services and scientific criteria upon which water quality objectives can be monitored. On a cost-recoverable basis, IWD can also provide the water quality data base upon which the objectives would be established (through surveys and

network monitoring) as well as evaluative ambient water quality monitoring programs.

IWD has been requested to serve on a bilateral INAC - Alberta committee to evaluate the establishment of water quality objectives on NWT-Alberta transboundary watercourses. The NWT Water Board and its consultant have consulted IWD intensively regarding the establishment of water quality objectives on watercourses within the NWT. Also, preliminary discussions have been held with Parks Canada regarding the establishment of water quality objectives on watercourses flowing into Nahanni National Park Reserve.

IWD may be requested by these managers to supply the baseline water quality data and/or the subsequent evaluative monitoring program. Resources must, therefore, be allocated accordingly when designing network and survey monitoring programs.

5.3 Interjurisdictional Agreements

The Mackenzie River Basin Committee, composed of Canada, Alberta, British Columbia, Saskatchewan, the Yukon Territory and the NWT, produced The Mackenzie River Basin Study Report in 1981. Focussing on integrated planning for the Mackenzie drainage system, the report made recommendations which have direct bearing on the NWT water quality program. The first recommendation called for a comprehensive

apportionment agreement, including water quality, among the jurisdictions. Bilateral agreements between adjacent jurisdictions must first be negotiated. Committee work is now underway to provide the groundwork for a negotiated water quality apportionment agreement between Alberta and INAC. The agreement will work towards the establishment of water quality objectives on principal transboundary watercourses.

The implications of these bilateral committees for the NWT water quality program are discussed in Section 5.2. Briefly, they indicate the IWD role for the provision of procedural and technical advice and the possible establishment of monitoring programs to support negotiated water quality objectives.

A second recommendation arising from the Mackenzie River Basin Committee called for the establishment of an integrated, long-time monitoring network that included water quality stations. This recommendation will be addressed, as permitted by available resources, when the NWT water quality program advances to the next step of detailed operational design.

5.4 Monitoring Strategies

5.4.1 Principles for Monitoring Design

An effective aquatic quality measurement and assessment strategy has to be established on a number of premises. First, due to the logistical

problems associated with sampling remote areas, it is essential that the water quality program be integrated with other environmental data gathering activities within the territories including hydrometric and other quality measurements. Second, a single purpose monitoring network cannot fulfill all of the information needs of the various issues. Rather, a combination of two levels of monitoring stations, recurrent basin surveys and special studies will be required. Third, to the extent possible in remote areas, sampling frequencies and parametric scope will have to be tailored for each site and for the measurement objectives. Fourth, water chemistry alone is inadequate. Rather, a multi-media approach will be essential to effectively achieve the objectives of the strategy. Fifth, it cannot be assumed that experience and knowledge obtained from waters of more southern temperate regions can be directly transferred to these northern waters. Thus, effort will have to be expended in the development and testing of scientifically sound measurement and assessment techniques suited to the environment. Also, research will be required to enhance and support the program. Sixth, the sensitivity of the northern aquatic environment to relatively small levels of contamination or stress must be assessed with respect to system stability. This is most likely a research type question but the strategy must attempt to consider and contribute to the study of system stress. Finally, this program tailored for the NWT must form a substantive and integral part of the National Water Quality Assessment Program. On this basis, the following elements have been identified as essential to the plan implementation.

5.4.2 Networks

A monitoring network is designed to provide sampling consistent over a relatively long term at important or representative sites. The data generated, although frequently inappropriate for certain purposes, is generally considered to be the best tool available to assist in the overall management of a water resource. The data generated may be used in the establishment of baseline conditions, the development of water quality objectives, measuring achievement of established objectives and under certain circumstances they are appropriate for determining trends and may be useful in environmental impact assessments. The advantage of a monitoring network is that there is generally a long term commitment to the program which is essential because the relatively low frequency of sampling requires a long period of record to fully reflect the variance present in an aquatic system. Additionally, the fixed frequency nature of the sampling simplifies logistics and assures continuity.

This strategy proposes two orders of network stations, the first will be referred to as "index stations" while the second are called "special stations". The rationale for each is discussed below.

(a) Index Station Network

The index station network, which is a component of the national index station network, consists of a series of fixed stations located at

critical locations within the NWT. These stations are high priority monitoring sites most commonly because of their proximity to interjurisdictional boundaries of major river systems. Other sites will be included because of their location, such as major river confluences, major shifts in drainage basin characteristics, river mouths and highly sensitive areas. The nature of these stations is such that a relatively high frequency of sampling is required (not less than six times per year) thereby requiring good year round access. These stations will also be selected on the basis of the historical record available for important sites. The stations will be operated with a high profile and on an ongoing basis to establish baseline conditions and possibly trends and for the establishment of aquatic quality objectives and assessment of compliance with these objectives.

(b) Special Station Network

In a remote area for which very little water quality information is available, it is essential to provide at least some information (e.g. for overview reports on aquatic quality) for a wide geographic area in a consistent fashion. Furthermore, it is important to be capable of responding to changing priorities and new development pressures without disrupting the index network. Therefore, a second level of network stations is proposed which will provide a similar level of information as the index stations but generally for a specific objective and for a shorter period of time. These stations initially should be used

primarily to provide baseline data for a wide geographic area essentially either in anticipation of future developmental pressure or in areas where available data are missing or inadequate. Interest in these stations may be shared by other agencies and cost sharing may be feasible.

Station siting initially will be on the basis of hydrological and water quality regionalization of the NWT. The underlying premise is that each of these stations will typify river systems of a broad area and this information can be generally transferred to like systems presumably with a minimal amount of corroborative data from the river of special interest. Identification of the index stations and the special station networks require that the current network be currently evaluated and rationalized.

5.4.3 Recurrent Basin Assessments

The need for a limited network of fixed long term and shorter term stations is essential within the context of a long term, broad based monitoring activity. However, such a structured program (i.e. fixed stations and sampling frequencies) alone, is neither an effective nor efficient means to sense the aquatic quality of a highly variable environment. Basin assessments are designed specifically to assess the natural variance of a dynamic water system within a relatively short time frame. In general, this is achieved through intensive seasonal and/or hydrologic event sampling. In this way, a better understanding of the

seasonal and long term site variance is achieved and the potential for understanding cause and affect processes is possible.

Recurrent basin assessments will span approximately three years including planning, data gathering and reporting. For this reason, basins will have to be carefully selected and ranked according to current priorities to ensure that the information is provided in a timely manner. The main purpose of these assessments is to establish conditions at a given point in time (baseline) and subsequently to follow up on changes due to development within the basin (trend or change assessment) or alternatively to provide more definitive information for basins having already experienced considerable development pressure.

In contrast to the monitoring network, basin assessments will also permit an expanded suite of environmental measurements, such as additional water chemistry, sediment, and biological work, as appropriate.

5.4.4 Special Studies

In addition to the monitoring networks and recurrent basin surveys, the water quality program in the NWT would be incomplete without the capability of undertaking special studies. Studies, distinct from the recurrent basin surveys, are problem-oriented and range from reconnaissance surveys to short-term and long-term comprehensive assessments. These studies tend to be focussed on specific water quality

problems. Studies are dynamic in design allowing for modification in accordance with findings. All aspects of the study are custom designed to fit specific goals and objectives as well as logistic constraints.

Initially, special studies in the NWT may be primarily at the reconnaissance level due to the limited available information. This approach may also be used as a pre-planning tool for a more intensive study. Studies will be directed at regional and national issues which could include, for example, aquatic sensitivity to acid rain assessments, the impact on surface waters of the long range transport and deposition of atmospheric pollutants and the stress of multiple development activities on system quality. The interdisciplinary approach of studies and the general and specific interests of other agencies (e.g. EPS, INAC) will promote joint effort in these undertakings, particularly those that are directed toward identifying and/or remedying regional-type problems.

5.5 Data Management

Too frequently, programs have been undertaken without explicit regard for ensuring comprehensive data management. The logistical restrictions of operating in the North will require joint and/or cooperative activities of a number of agencies. If the objectives of the strategy are to be achieved, there must be some mechanism of data management. This strategy proposes that NAQUADAT remain as the primary data bank for the north. This data base can only be enhanced through full cooperation of other

agencies, especially those which have related monitoring responsibilities (e.g. INAC, EPS). This will require considerable effort to establish the "protocol" initially and will likely require continued assessment at a working level.

The high costs of operating a water quality program in the NWT require that more than ordinary effort be placed upon ensuring data of high standards. The field and laboratory quality assurance programs will need to be designed for each of the monitoring networks, the recurrent basin surveys and the special studies. The principles of design should conform with those employed within the water quality program throughout the region as established by the regional quality assurance coordinator.

There is also a need for assessing comparability of inter-agency data. This is a more difficult task due to the number of agencies involved but is essential if efficiencies in data collection and synthesis are to be achieved. The details for this element need to be established as part of the communication element of the strategy.

Information Synthesis

Extensive effort is generally placed upon collecting and storing informative, high quality data without planning for its synthesis and presentation for the identified users. It is tacitly assumed that this critical activity will occur. Experience clearly indicates the need for

identifying and planning this step. To this end, three components must be recognized, specifically:

(i) synthesis of the network data and recurrent basin survey data to report on results and contribute to evaluation of the activity;

(ii) interpretation of the special study data relative to the objectives; and

(iii) integration and synthesis of relevant environmental data (e.g. habitat studies, waste loadings, etc.) to provide information to the public, data users and managers in a timely and comprehensive manner.

5.6 Research And Communication

An intensive water quality program for the NWT, as outlined here, is made necessary because of the inadequacy of the historical data base and of current monitoring activities. The northern environment has tended to be ignored because of its perceived pristine state and the logistical problems stemming from its size and remoteness.

As noted above, many of the premises and procedures adapted for southern waters are likely to be inappropriate in these Arctic and sub-Arctic environments. It is essential that research programs in the NWT be encouraged and integrated with the water quality program if either are to be effective. Therefore, a research advisory and liaison function is required which will involve key staff from the operations group (e.g. IWD, INAC), the government research community (e.g. National Water Research Institute, National Hydrological Research Institute, EPS, DFO)

as well as representatives from the university and private research community. This group should meet periodically to discuss needs, ongoing activities and findings. It should also be charged with the responsibility of scientifically reviewing activities.

This strategy also includes a component which is directed at communication and integration as a means of enhancing the effectiveness of the program. The role of communication stems far beyond that of government agencies and must incorporate a means of advising and responding to a variety of publics including communities, regional councils, media, schools and non-government environmental organizations.

Details of the research liaison activities and communication responsibilities should be prepared by appropriate agencies as they are beyond the scope of this strategy. The success of this strategy, however, is interdependent upon both of these components.

6. RESOURCE REQUIREMENTS

The resources required to implement the NWT water quality program over a five year planning horizon are listed below. These resource requirements were submitted to IWD Senior Management as a New Initiatives B-Base budget request. INAC has recently requested DOE to open up negotiations for a NWT Water Quality Agreement. Those resources identified as cost-recoverable are an estimate of INAC's ultimate share of implementing such an agreement.

Table 2

	Year 1	Year 2	Year 3	Year 4	Year 5
PY's	1.1	3.0	7.0	7.0	7.0
Salaries	48.0	109.4	230.8	230.8	230.8
O & M	30.0	60.0	105.0	105.0	105.0
Capital	8.0	15.0	10.0	10.0	10.0
TOTAL	86.0	184.4	345.8	345.8	345.8
cr - Salaries	-	31.5	66.0	66.0	66.0
cr - O & M	-	14.2	36.5	36.5	36.5
cr - Capital	-	7.5	2.5	2.5	2.5
cr - TOTAL	-	53.2	105.0	105.0	105.0

PY's

Year 1 - PC3 - Yellowknife

Year 2 - PC3 - Yellowknife
- PC2 - Yellowknife
- BI2 - Yellowknife

Year 3-5 - PC3 - Yellowknife
- PC2 - Yellowknife
- BI2 - Yellowknife
- EG6 - Yellowknife
- CR3 - Yellowknife
- EG4 - Saskatoon Laboratory
- EG4 - Burlington Laboratory

7. GLOSSARY

IWD - Inland Waters Directorate

NWT - Northwest Territories

WQB - Water Quality Branch

NWT Water Quality Program

- a program administered by IWD in Yellowknife and which receives functional guidance and support from the IWD-WQB in Regina;

- designs and implements an ambient water quality monitoring system of networks, surveys and special studies; participates and concludes interjurisdictional water quality monitoring agreements as required; aids in the establishment of water quality objectives relating to transboundary and interior watercourses of the NWT.

Ambient water quality monitoring

- the characterization of water quality of watercourses both pristine and subject to anthropogenic inputs, and which may describe water chemistry, sediment chemistry and biological parameters;

- an activity not directly associated with effluent discharges or regulatory monitoring;

- may be carried out using networks, recurrent basin assessments, and special studies.

Water quality objective

- a numerical concentration limit or narrative statement, based on water quality guidelines and relevant socio-economic factors, which has been negotiated to support and protect the designated uses of water at a designated site.

Baseline water quality information

- information on pristine or degraded waters against which future changes in water quality can be measured.

GNWT - Government of the Northwest Territories

ECS - Environmental Conservation Service

EPS - Environmental Protection Service

LUP - NWT Land Use Planning, a joint undertaking by INAC and GNWT

INAC - Indian and Northern Affairs Canada

WSC - Water Survey of Canada

LRTAP - Long Range Transport of Air Pollutants

TCMP - Toxic Chemicals Management Program

MRBC - Mackenzie River Basin Committee

DFO - Fisheries and Oceans Canada

DOE - Environment Canada

IWD-SM - IWD Senior Management

Freshet
- the annual period of high flows occurring in the spring often as a result of precipitation, and snow melt.

FY - fiscal year

Multi-media monitoring
- water quality monitoring which includes chemical and physical analysis of the water column, sediments and biota associated with a watercourse.

DHW - Health and Welfare Canada

CWS - Canadian Wildlife Service

AES - Atmospheric Environmental Service

Water quality resources mapping
- the mapping of themes (e.g., water resources uses, sensitive aquatic habitats, effluent discharges, existing development scenario, projected development scenario, land tenure) on clear mylar overlays which are placed over a hydrologic base map for the purposes of issue definition and system analysis.

IBP - International Biophysical Program

NAQUADAT
- National Water Quality Data Base, operated by IWD, which stores chemical, physical, bacteriological and hydrometric data for rivers, lakes, ground water, precipitation and wastewater.

NWRI - National Water Research Institute

NHRI - National Hydrology Research Institute